

CH2MHILL

CH2M HILL
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Suite 1500
Cincinnati, OH
45202-4157
Tel 513.762.7605
Fax 513.721.4628

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March 11, 1998

143104.RP.03.09

Mr. Michael McAteer, WAM (5HSRL-6J)
U.S. Environmental Protection Agency, Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3590

Subject: Evaluation of SimulProbe Technology for Potential Use at the Enviro-Chem
Superfund Site in Zionsville, Indiana

Dear Mr. McAteer:

At your request, attached is CH2M HILL's evaluation of the SimulProbe™ technology with respect to its use for collection of confirmatory soil samples at the Enviro-Chem site. Heather Saxe, a hydrogeologist in our Dayton, Ohio office, prepared the evaluation. Please call me if you have any questions or need additional information - 513/762-7605.

Sincerely,

CH2M HILL

Timothy D. Harrison
Site Manager

CIN\Simulprobe.doc
Enclosures

c: Steve Nathan/PO/USEPA; 5HSM-5J (w/o enclosure)
Peggy Hendrixson/CO/USEPA; 5MCC-10J (w/o enclosure)
Ike Johnson/PM/MKE
Al Erickson/RTL/MKE
Heather Saxe/DAY
Gail Gill/AA/MKE

SimulProbe Technology and Potential Use at Enviro-Chem Site in Indiana

TO: Mike McAteer/U.S. EPA Region 5

COPIES: Jeff Keiser/CH2M HILL-MKE
Dan Plomb/CH2M HILL-MKE

FROM: Heather Saxe/CH2M HILL-DAY
Tim Harrison/CH2M HILL-CIN

DATE: March 11, 1998

This memorandum summarizes available information about SimulProbe™ technology and its possible use for soil (and potentially soil gas) sampling at the Enviro-Chem Site in Zionsville, Indiana.

Description of Technology

Specific literature describing the SimulProbe technology is attached to this memorandum. In general, the SimulProbe is a site screening and multimedia sampling device that can be used with any drilling method suitable for site conditions. The SimulProbe's sampling technique permits soil vapor or groundwater sampling to be conducted at the same depth as soil sampling. The SimulProbe uses split-tube, stainless steel drive samplers with thin-walled stainless steel liners for soil collection. A gas transfer interface and Teflon or polyethylene tubing attached to the top of the probe is used for soil vapor collection.

The SimulProbe is driven into undisturbed soil to collect soil samples. The sampler uses a SimulProbe Latch Activated Tip (SPLAT) system for soil collection. At the desired interval, the operator pulls back on a wire line/drive rods to release the SPLAT drive cone and drills another 18 inches to fill the split tube. After the sampler is driven into the soil, it is withdrawn a few inches to retract the sampler from the drive shoe and expose a screen for soil gas sampling (using a technology similar to Hydropunch™ for groundwater sampling). Soil gas enters through the screen, passes upward through the split tube sampler and up to the surface where each sample is collected. At the surface, the end of the tubing is attached to a vacuum pump. A photoionization detector (PID) monitors the soil gas for organic vapors. Samples are collected after the tubing is purged and the organic vapor concentrations are stabilized.

The SimulProbe Aquifer water canister is used with or without the soil sampler to collect water samples. The canister is pressurized with nitrogen gas to obtain discrete samples and to minimize the potential for loss of volatiles during retrieval. The sampler is lowered to or driven to the depth where the sample is desired. The gas is slowly bled off to the surface, and water enters the canister through a one-way reed valve system. This approach provides water samples without purging. If purging is required, pumps may be used with the water canister. At the surface, pressure is bled off, and a tube is inserted into the boom reed valve to decant the water samples to the sample containers.

CH2M HILL Experience with SimulProbe

To date, the majority of our known experience with SimulProbe is in our western US offices. Typical projects for these offices were water quality investigations involving drilling to depths of several hundred feet in consolidated materials (air rotary) and water sampling. Ken Shump/CH2M HILL (Portland office) indicated that our California offices, particularly Sacramento, are the most familiar with the method for deep drilling applications. Tim Graves/CH2M HILL (Phoenix office) also spoke favorably of the method but acknowledged that he only actually watched the method in use for less than a day.

Considerations

1. The SimulProbe technology is not limited by depth. Instead, its use is limited to how deep the particular drilling method can go.
2. Drilling with a method such as hollow stem auger would require the larger Maxi-Probe. With direct push rods, the smaller Mini-Probe can be used.
3. The vacuum necessary for soil gas sampling will vary with soil type; higher purge rates are necessary in tight soils.
4. SimulProbe recommended the use of direct push technology to limit the number of necessary trips downhole (as opposed to hollow stem auger, which would require removing the rods each time a new auger flight is advanced). Direct push technology is typically less expensive than hollow stem auger drilling/sampling and should be suitable for drilling to depths of 20-25 feet. For much greater depths, direct push drilling is not recommended. When choosing a drilling contractor for this site, CH2M HILL recommends investigating the driller's familiarity with the site area and then choosing a drilling method based on driller recommendations and our site knowledge.
5. Due to the sampling technology, soil and groundwater samples cannot be sampled from a specific interval once you have drilled deeper. In other words, if, after screening soil gas throughout the entire depth of the borehole, a sampling interval of 6-7 feet below ground surface is desired, a new borehole must be advanced to collect a sample in that interval. It may be advisable to collect several samples for possible analysis during the drilling rather than let a potential sampling interval "pass."
6. The size of the MiniProbe (recommended for use with direct push drilling) is slightly smaller than that of a typical split spoon sampler. The MaxiProbe (used with hollow stem auger drilling) is larger than a split spoon sampler. Any of these samplers should provide a sufficient quantity of soil to collect analytical samples for VOCs for both CH2M HILL and the PRPs (assuming 4 oz. sample container). Duplicate samples may require advancing an adjacent borehole to the specified depth if the MiniProbe sampler is used, or if any sampler does not yield full sample recovery.

Potential Drilling Contractors

Mr. Darin Meyer/SimulProbe Technologies mentioned several drillers familiar with or owning the SimulProbe technology:

Geosampling - The Probe
Kalamazoo, MI
(616) 384-4198
Contact: Scott Dembrewske

GeoSampling has purchased the SimulProbe equipment and can conduct drilling and sampling

EDAC (Environmental Drilling and Contracting)
Holland, MI
(616) 393-9300

Is familiar with SimulProbe

Alliance Environmental, Inc.
Marietta, OH
(614) 374-6726

Is familiar with SimulProbe

Please note that this list gives drilling contractors who are already experienced with the technology and does not imply a recommendation. Other drilling contractors could be trained on this technology relatively inexpensively.

Advantages/Disadvantages

A main advantage of the SimulProbe sampling system is the ability to conduct a soil vapor survey simultaneously with soil sampling activities, thus eliminating the need for a separate investigation. Field screening and installation of monitoring wells during the same investigation mobilization is another advantage.

Mr. Meyer was quick to point out that for only soil sampling at the proposed site, sampling using a split-spoon sampler (or direct push soil sampling) and a PID would serve the same purpose as the SimulProbe. The benefit to SimulProbe sampling in this application is that it would provide an insitu soil gas and soil sampling technique that would minimize volatilization and assist with determination of potential "hot spots." The SimulProbe is capable of collecting soil gas measurements, whereas the split spoon sampler is not.

Potential users of the SimulProbe technology should remember that some start-up time is necessary to become familiar with the technology. This may be accomplished by either working with a driller familiar with the technology or by having SimulProbe staff train CH2M HILL staff (and its drilling subcontractor) ahead of time or in the field. Timing and costs should be considered when evaluating the technology.

Approximate Costs

Darin Meyer/SimulProbe provided a price quote (see attached quote) for drilling oversight and collection of approximately 20 soil samples from boreholes up to about 20 feet in depth using the Drive and Sniff (borehole "screening") technology. This quote was provided for our informational purposes only. The quote assumed that Mr. Meyer would operate the equipment; another option would be to have Mr. Meyer come onsite for a day to show the onsite geologist/engineer and drillers how to operate the equipment. The quote included

all equipment rental charges and all expendables (such as the soil-gas kits and Teflon tubing) related to the operation of the SimulProbe. The quote does not include the rental of a PID or necessary health and safety equipment (e.g. combustible gas indicators). Laboratory analytical costs are also not included in the quote.

Recommendation

The SimulProbe technology is an innovative and proven technology that has significant advantages for specific applications compared to traditional split spoon sampling technology. Based on discussions with SimulProbe Technologies and CH2M HILL staff and our current site understanding, CH2M HILL recommends SimulProbe technology for soil confirmation testing at the ECC site because of the following:

- SimulProbe technology provides the capability to use soil gas organic vapor measurements and simultaneous soil sampling methods to target areas of suspect residual VOC contamination.
- Use of the technology presents a relatively low increase (approximately 30-60% for this application) in cost for the anticipated improvement in "hot spot" delineation capability in the field versus traditional split spoon sampling methods.
- Sample volumes are comparable to those achieved using split spoon samplers.

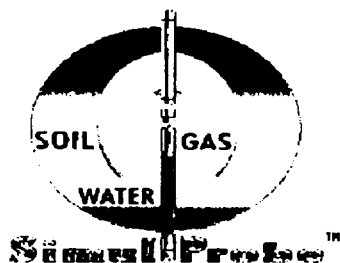
Prior to the start of the field effort, CH2M HILL recommends investigating preferred drillers (either those drillers with whom CH2M HILL has a good working relationship, or those drillers familiar with the technology) to decide which firm would be the best candidate for field activities at the site. Required sample volumes (including analytes and laboratory method requirements) should also be considered when determining the drilling method (direct push or hollow stem auger) and resulting SimulProbe samples (Mini- or Maxi-Probe) to be used onsite.

SimulProbe Contact Representatives

The following are two SimulProbe Technologies offices and contact names:

SimulProbe Technologies, Inc.
316 W. Dutton
Kalamazoo, MI 49001
616-382-1854
W. Richard Laton, Senior Hydrogeologist
Darin P. Meyer, Hydrogeologist

SimulProbe Technologies
354 Bel Marin Keys Blvd, Suite F
Novato, CA 94949
1-800-553-1755
Noah Heller, President



SimulProbe Technologies, Inc

316 W Dutton, Kalamazoo, MI 49007

(616) 382-1854

(616) 382-2076 (fax)

To: Heather Saxe

From : Darin Meyer

Company : SimulProbe Technologies, Inc.

Fax Number : +1 (616) 1937 228-7572

Fax Number : 1-616-382-2076

Subject : Quote

Pages including cover page: 2

Date : 3/3/98

Time : 10:49:00 AM

MESSAGE

Heather,

This is the upper end quote. You probably won't need to change out the Teflon tube after every hole, so you won't need all 500' of Teflon. Also my hours will change if you want me there for one day only. The Nitrogen tank et al. is for deconing the Teflon tube after each hole. It not only purges the line it dries it too.

Thank You,

Darin Meyer



SimulProbe Technologies

316 W Dutton
Kalamazoo, MI 49007
616 382-1854 fax 616 382-2076

Quotation # dpm-10004

QUOTATION

Customer

Name CH2M Hill
Address One South Main Street
City Dayton State OH ZIP 45402
Phone 937 228-4285 937 228-7572 (fax)

Date 3/3/98
Order No
Rep
FOB

Qty	Description	Unit Price	TOTAL
1	Mini SimulProbe (per week)	\$500 00	\$500 00
1	soil gas vacuum pump (per week)	\$150 00	\$150 00
30	soil-gas kits for mini	\$14 50	\$435 00
1	hose spool/nitrogen tank/regulator (weekly)	\$150 00	\$150 00
500	Teflon tubing (per foot)	\$1 25	\$625 00
24	Labor (includes meals, lodging and vehicle) (based on \$50/hr and approximately 8 hour days)	\$50 00	\$1,200 00

P.O. Number:**Contact Name:** Heather Saxe**STI Contact:** Darin Meyer**Payment Details**

- ☒ Cash
☐ Check
☐ Credit Card

Name
CC #

Expires

SubTotal \$3,060 00
Shipping & Handling
Taxes

TOTAL

Office Use Only

This bid is only good for 30 days from the date above

Your Environmental Specialists

**For more information contact one
of the following specialists**

▼ **Noah Heller, M.S., R.G.**

President

▼ **Mark Blaidsell**

Director of R & D

▼ **Reed Richter, Ph.D.**

Marketing Director

▼ **W. Richard Laton, Ph.D.**

Senior Hydrogeologist

▼ **Darin P. Meyer, M.S.**

Hydrogeologist

▼ **Ernst-Dieter Meineke, Ph.D.**

SimulProbe Technologies, Inc.

354 BelMarin Keys Blvd. Suite F

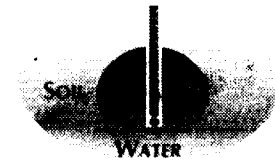
Novato, CA. 94949

P: (800) 553-1755

F: (415) 883-8788

E: sprobe@well.com

SimulProbe Technologies, Inc.



SimulProbe

*The sampling tool of the
next century.*

SimulProbe Technologies, Inc.

354 BelMarin Keys Blvd.

Suite F

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(800) 553-1755

SimulProbe Technologies, Inc.

SimulPhasic Sampling is:

The collection of soil/soil-gas or soil/groundwater samples as intrinsically linked data sets, allowing for a better estimate of contaminant partitioning, mass and location.

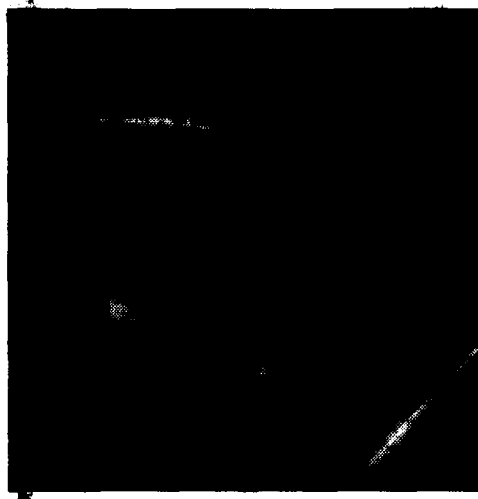
- ▼ **BETTER DATA** - Intrinsically linked data sets are precisely correlated with host geology.
- ▼ **TIME EFFICIENT** - One trip downhole to collect soil/soil gas or soil/groundwater samples.
- ▼ **COST EFFECTIVE** - Fewer sampling events and better sampling programs reduce subcontractor labor and lab costs.

SimulProbe can be used with most drilling methods:

Hollow Stem	CPT
Mud Rotary	Vibratory
Air Rotary	Push Technology
Cable Tool	Sonic
Dual Tube	Horizontal/Directional

Better Data

In-Situ Headspace Test yields more accurate screening results than traditional glass jar or baggie headspace tests. Intrinsically linked data sets are precisely correlated with host geology. Thus, yielding fewer false negatives.

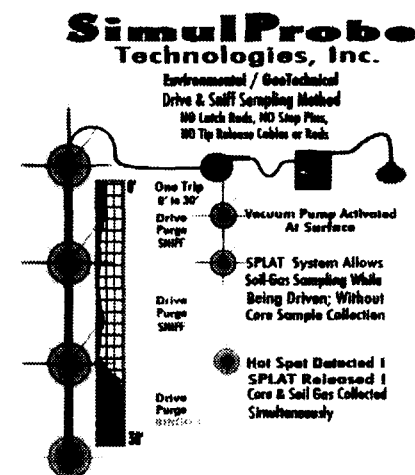


Time Efficient

Reduced man-hours, one trip downhole yields two correlatable samples. Soil/gas/groundwater vertical profiling during the site characterization provides the data needed to precisely delineate contaminant plumes. Ideal for *Brownfield* site development and characterization.

Cost Effective

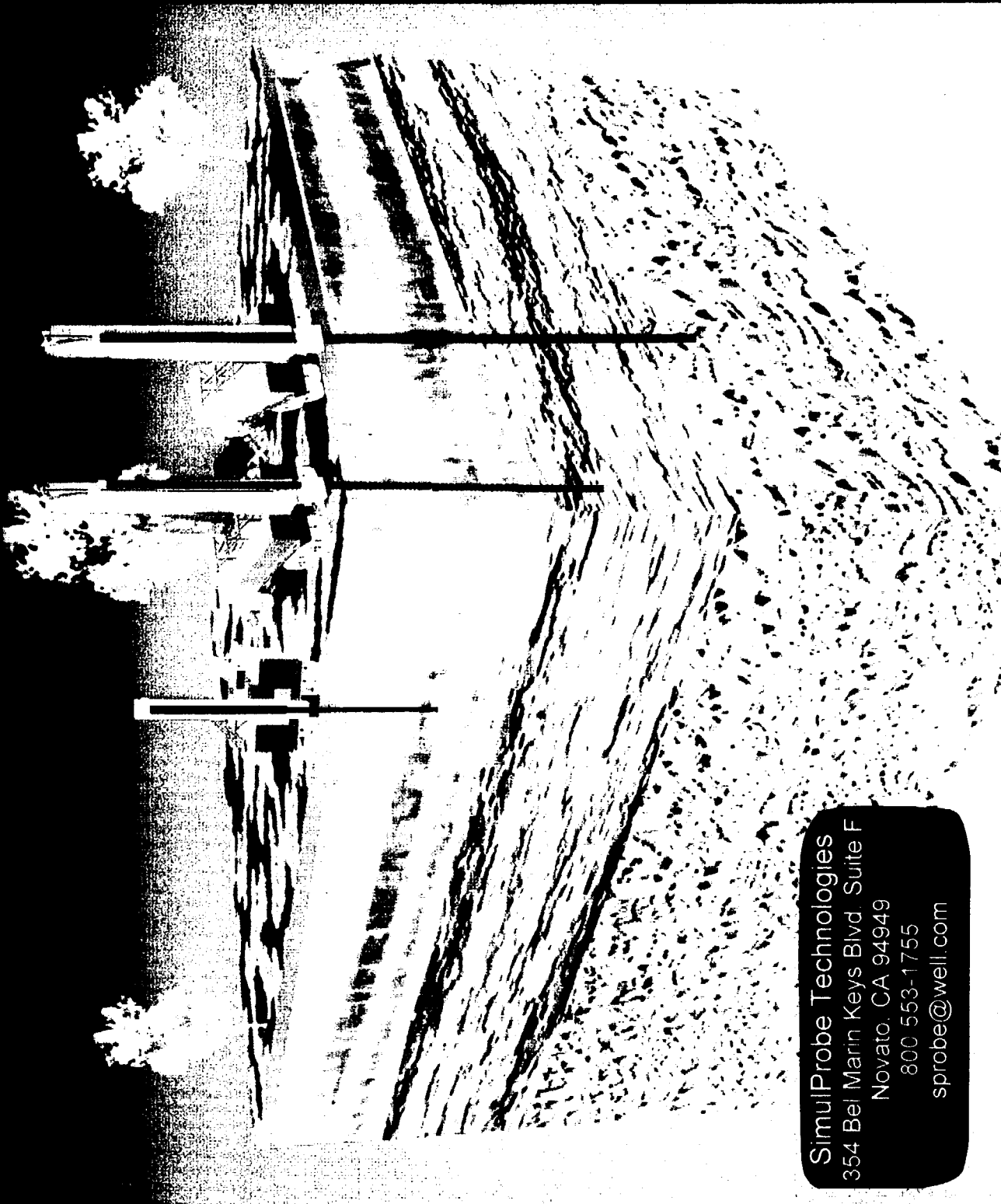
Fewer sampling events and better sampling programs help reduce subcontractor labor and lab costs. Using one tool instead of two provides cost effective sampling. Eliminating lab costs on ND samples through better screening methods.



Other Applications:

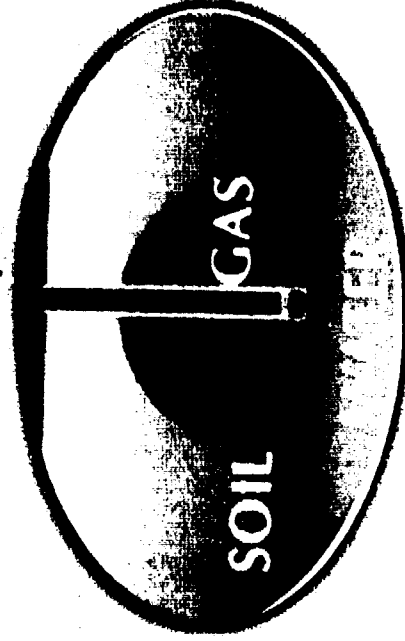
Aquafiler

- ▼ Lake, river, and ocean sampling
- ▼ Vertical profiling of open water bodies
- ▼ Micro-purged water sampling downhole
- ▼ In-situ delivery system for other instruments
- ▼ Sampling water body bottom sediments
- ▼ Wetland delineation

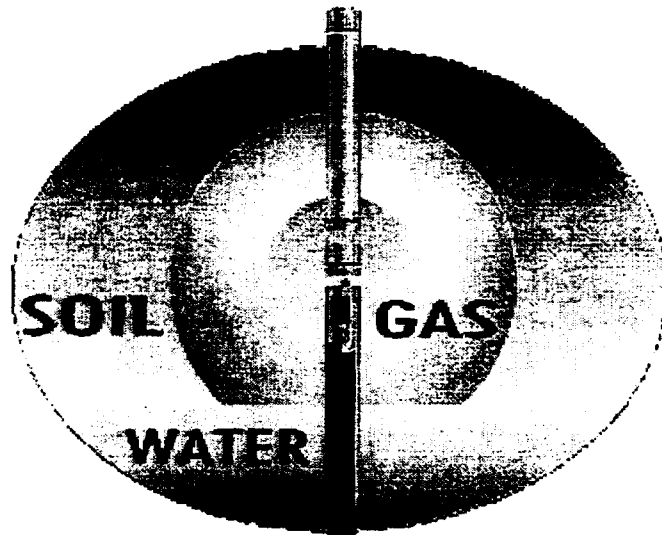


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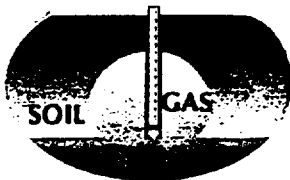
**SimulProbe Sampling
Fast In Situ Testing**



SimulProbe

HAVE YOU HEARD WHAT
LEADING DRILLING COMPANIES
ARE SAYING ABOUT THE
SIMULPROBE™?

"THE MOST CONSISTENTLY
CLEAR DISCRETE GROUND
WATER SAMPLES-MORE SO
THAN HYDROPUNCH®"



SimulProbe Technologies, Inc.

150 Shoreline Highway
Bldg. E, (2nd Flr.)
Mill Valley, CA 94941

phone (800) 553-1755

fax (415) 331-2665

e-mail: sprobe@well.com

8-4-97

To whom it may concern,

I just wanted to touch base and inform you of some of our end user feed back with respect to using the SimulProbe. The package that I've sent to you contains letters of recommendation from various sources; including Water Development Corporation (WDC) - a prominent drilling company which has used the SimulProbe extensively for MTBE characterization in Santa Monica, CA.

One of the points which was made in the WDC letter was their observation that the SimulProbe collects very clear water samples on a consistent basis when using the tool with mud rotary drilling, and "on a more consistent basis than the HydroPunch". Since WDC now has extensive knowledge of the SimulProbe's performance with mud rotary drilling, WDC's comparative observation with the HydroPunch would seem to imply that the SimulProbe either 1) forms a more effective seal with the formation than the HydroPunch, 2) does not take on drilling fluid through joint connections in the mud rotary rods since the use of the SimulProbe is independent of these rods, 3) does not suffer from the bailer turbidity effects since the SimulProbe is used independent of a bailer - utilizing its nitrogen back pressure method, and 4) all or some of the above. If their observations are correct, then this would seem to imply that the SimulProbe's advantages over the HydroPunch are not limited to the use of mud rotary drilling, but likely extend to other drilling methods as well.

The other letters of recommendation which I've included in this package discuss the application of the tool in natural attenuation studies, deep groundwater studies, and soil gas investigations. Please note that in the Levine & Fricke letter, the SimulProbe was used successfully to depths of 700 feet below ground surface for a TCE investigation in Scottsdale, Arizona. Because of the sensitive nature of the Scottsdale job, Dr. John Cherry from the University of Waterloo was hired as a consultant by one of the RPs to review the investigative data. In a face to face discussion that I had with Dr. Cherry on November 20, 1996, at the McLellan AFB Expedited Site Characterization Conference, Dr. Cherry described the SimulProbe data results from the Scottsdale job as being "quite good".

If you have any questions with respect to these documents, please do not hesitate to call me at (800) 553-1755. Thank you for your time to review this information.

Best Regards,

A handwritten signature in black ink, appearing to read 'Noah R. Heller'.

Noah R. Heller, MS RG
President, SimulProbe Technologies, Inc.

SimulProbe Technologies, Inc.
Tools for Cased Hole, Direct Push, CPT, and Mud Rotary
Advantage Summary

STI produces a “cutting edge” sampling system. The SimulProbe can collect soil/soil-gas or soil/groundwater samples simultaneously. With one tool and one trip down hole one can obtain correlated soil and soil-gas, or soil and groundwater samples. The water and gas samples are collected from the same stratigraphic horizon as the core and come from the area surrounding the core sample, not from the core itself. The tools are adaptable to virtually any type of drill rig: direct push, cased hole, CPT, or mud rotary.

Its advantages are:

- **Reduced Man-Hours, Equipment Rental and Drilling Costs** -- one trip downhole yields two correlated sampling events.
- **Better Science** -- correlated data sets yield a more accurate determination of the nature and extent of contamination and a better picture of its relation to host geology.
- **Combine a Feasibility Study Phase with the Remedial Investigation Phase for a Cost Savings** -- concurrently with Remedial Investigation sampling, correlated flow permeability data, O₂/CO₂ ratio data, and microbial data can be collected. Place pilot SVE wells according to subsurface air flow rather than lithology alone. Collect necessary information for fate and transport, and bioremediation or natural attenuation decisions. Assess whether a site is a good candidate for such remediation.
- **Superior In-Situ Sensor Ground Water Samples** – more time- and cost-efficient than a HydroPunch[®], or BAT[®], with equal or superior quality. Often the turbidity values are as low as 40-50 NTU's without filters-- even in mud rotary. The water canister can be back-pressured with nitrogen to minimize VOC loss and fluid cross-contamination.
- **Much Less Refusal** – no tip or cone is driven ahead of the SimulProbe core barrel to hinder penetration. A 680-pound downhole hammer can be used to core into places no other in-situ ground water or soil-gas samplers will go.
- **SPIHT (SimulProbe In-Situ Headspace Test)** – more accurate than a full-scale paired soil/soil-gas survey at a fraction of the cost. SPIHT is far more accurate than glass jar or baggy headspace tests. SPIHT eliminates VOC loss and yields far fewer false negatives, streamlines the selection process for VOC lab analysis of soil or soil-gas samples, and saves substantial lab costs.
- **Drive and Sniff**-- the ability to sample and characterize an entire borehole from surface to contaminant source with one tool and one trip down hole.
- **SPLAT (SimulProbe Latch Activated Tip)** -- the SimulProbe Core Barrel and Mini-SimulProbe have a revolutionary, semi-automatic direct push tip and is adaptable to most direct push rigs, including GeoProbe[®] and CPT, and is far more time- and cost-efficient to use than GeoProbe samplers.
- **A Mud Rotary First** -- SimulProbe's SPLAT, fill detection, and shut-off valve system combine to offer a patent pending process that for the first time enables extremely time- and cost-efficient in-situ soil, groundwater, and soil-gas samples to be delivered using a mud rotary rig system. This is accomplished without having to change out or remove the mud.
- **The SimulProbe Core Barrel** -- the industry's first truly environmental split spoon for cased hole applications. The SPLAT is the only tip-release system that can be used on a wireline. Our core barrel can be driven with a downhole hammer past potentially contaminated sluff, air diluted soil created by air rotary or dual tube percussion drilling methods, and the mud infiltrate zone created by mud rotary drilling. It can minimize false positives and negatives.

A Mud Rotary First

The SimulProbe SPLAT™ (SimulProbe Latch Activated Tip) and the fill detection/shut-off valve system combine to offer (patent pending) a process that *for the first time* enables quality, extremely time- and cost-efficient in-situ environmental samples (soil and soil gas, or soil and groundwater) to be delivered using a mud rotary rig system.

Collecting a quality water or soil gas sample with a mud rotary drill rig is currently highly problematic. A drive rod and bailer sampling system is subject to the high specific gravity and pressure of the borehole mud. And it is difficult to keep the drilling mud out of the collected sample. In mud rotary and hollow stem auger applications, drive rods often bend causing the sampler to "egg" the formation. This egging can cause a breach between the sampling port and the bore hole environment. Such breaching can result in cross contamination and sample degradation. Another common method is to remove the mud from the borehole and replace it with potable water and then do a high volume purge using a submersible pump. Sometimes a packer is placed above the pump to attempt to isolate the purged zone from the static fluid column inside the borehole. This process is very time consuming and very costly. The purge fluids have to be containerized, tested, and disposed of properly. Also, the electric submersible pump (and packer) must be lowered on connector rods to the target depth, and must be retrieved and decontaminated accordingly, also very expensive. Finally, a high volume purge may dilute the contaminant concentrations and render the sample useless.

The solution is to use the Mini-SimulProbe with the 1-liter water canister attachment, fill detection/shut-off valve system, and the SPLAT (SimulProbe Latch Activated Tip). A condom over the Mini-SimulProbe assembly protects the integrity of the core barrel and helps secure the SimulProbe SPLAT on the way down. Now one can use a wireline to lower the assembled SimulProbe down through the open mud rotary coring bit. It is not necessary to change out the mud before collecting an environmental sample. The Mini-SimulProbe has the only tip system in the industry that can be wire-line operated and driven with a down hole hammer to eliminate egging. The natural expansivity of most soils prevent any breach with the bore hole environment. At the bottom of the borehole pound the Mini through the mud infiltrate and about two to four feet into the aquifer. The condom will strip away and form an annular seal around the tool at the bottom of the borehole. The investigator opens the shut-off valve at the base of the water canister, and then the tool is pulled back about 6 to 12 inches to form an unsupported cavity. Pulling back allows the release of the SimulProbe SPLAT and easy access of the groundwater to the core barrel and screened fluid pathways. Water will fill the cavity and hydrostatically pass through the two Teflon lined fluid pathways inside the tool as well as through the core barrels itself. The SimulProbe's fill detection system will let the investigator know when canister is full. Once sufficient fluid quantity is collected, the SimulProbe is then driven forward to collect the corresponding soil sample. The soil sample pushes the SPLAT to the top of the core barrel, thereby recovering the SPLAT on every sampling event. At this point the investigator closes the shut-off valve, and pulls the tool to the surface for a high quality, relatively undisturbed water sample. The shut-off valve seals the canister and protects the water sample as it travels through the mud to the surface.

SimulProbe Technologies

354 Bel Marin Keys Blvd

Suite F

Novato, CA 94949

(800)553-1755

Introducing the Aquafiler™

A pneumatic wire-line operated water canister sampling system for wells and other surface water applications.

- With one tool and one trip down-hole, obtain real-time subsurface in-situ water parameters combined with highly accurate, low turbidity, water samples for up-hole analysis. Real-time in-situ water parameters are more accurate than ex-situ parameters recorded up-hole. Depth specific water samples are collected from a 1-inch horizon.
- Sample and discretely profile any depth interval with one tool and one trip down-hole.
- Wire-line operation and depth specific sampling offers maximum flexibility for easily establishing or modifying an existing sampling plan (especially compared to fixed array well sampling systems).
- Eliminate high flow-rate purge expense and inaccuracy: low flow-rate purge capability, but also ideal for non-purge sampling.
- Pneumatic operation: no down-hole pumps, no electrical systems or cords, no moving parts, less potential down-time.
- High quality data: nitrogen back-pressurization minimizes VOC loss; low flow rate sampling minimizes turbidity.
- Large sample volume capability: collect from 0 to 10 or more liters from any specific horizon.
- Get beyond floating product or contaminated zones with minimal cross-contamination.
- One tool for diverse surface water applications: plume delineation; monitoring NPDES permits; coastal, reservoir, and dredging studies; and wild life ecological studies.

Environmental Sampling Specialist
sprobe@well.com

New England Environmental Exposition
Rapid Site Screening using the SimulProbe™ Multimedia Sampler —
Case Histories and Future Directions
Donald L. Marcus, R.G., C.E.G., Senior Supervising Geologist
Chris L. Bonds, Project Geologist
EMCON, Burbank, CA

Executive Summary

The remedial investigation and feasibility study (RI/FS) process, has historically been slow, costly, fragmented, and iterative. All of this is changing with the invention of the SimulProbe™ sampler. Used in concert with standard drilling and direct-push site characterization equipment, the SimulProbe™ lets geologists and engineers rapidly screen a site. Furthermore it is unique because it enables simultaneous determination of the vertical and lateral extent of soil, soil vapor, and groundwater impacts. Unlike other site screening and sampling equipment, SimulProbe's patented SimulPhasic® sampling technique permits soil vapor or groundwater sampling at the same time, and at the same depth, as soil sampling. A new process, Fast In Situ Testing (FIST), can estimate vadose zone and aquifer permeability during sample acquisition. FIST uses electronic data acquisition to accurately measure flow-rate, pressure/vacuum, temperature, time, and other sampling parameters. This process provides discrete estimates of pneumatic and hydraulic permeability in the earliest phases of site characterization, optimizing media sampling, monitoring, and remediation well design. Use of the SimulProbe™ in the Rapid Site Screening Process (RSSP) empowers the environmental professional with new and more cost-effective approaches to site assessment and remediation.

Industrial activities released hazardous substances into the subsurface at a Resource Conservation and Recovery Act (RCRA) status aerospace facility and a Comprehensive Environmental Response Compensation and Liability Act (CERCLA) agricultural applications facility, both in California. Numerous assessments identified areas of impact, and several interim actions occurred. Additional investigations screened the site to identify remaining areas of impact, and help design systems for comprehensive remediation. Investigators used conventional hollow-stem-auger drill rigs, standard California Modified split-spoon samplers, and SimulProbe™ samplers in conjunction with on-site mobile laboratories to provide real-time data. These timely data empowered regulators, consultants and responsible parties, to jointly decide to deepen, add, or delete borings. This approach eliminated the need for follow-on investigation and provided data useful for designing final site remedies.

Soil vapor data gathered at the RCRA site identified additional areas of impact as well as varying degrees of effectiveness of previous interim vapor extraction. The SimulProbe™ sampler's oversized sleeves provided adequate soil for a broad suite of field screening and laboratory analyses. These data helped to pinpoint the location of several impacted areas. The SimulProbe™ sampling program at the CERCLA site provided the real time data required to determine the need for, and to help design, a vapor extraction system on the fly.

In addition to the above EMCON has used the SimulProbe™ Aquifer water canister, to cost effectively profile groundwater concentrations, within an aquifer. A sensor array installed within the water Aquifer provided real-time, in situ, measurements of dissolved oxygen, redox, conductivity, pH and temperature. These data when combined with laboratory analysis of the depth discrete water samples obtained by the sampler quickly and efficiently identified variations within the aquifer. These data were used in the design of an in situ remediation system.

The SimulProbe™ environmental media sampling system has demonstrated itself a very useful enhancement to RSSP. The ability to collect more types and better quality data makes it easier for both consultant and regulator to make decisions on the sufficiency of data, thereby eliminating the

need for iterative investigations. Based on our experiences the SimulProbe™ can save from 20-40% of site characterization/remedial system design costs and months of time when used instead of a conventional phased investigation and design/build approaches.

Introduction

The SimulProbe™ multimedia sampling system enables the simultaneous collection of soil and soil vapor or groundwater samples. Unlike the Geoprobe™ and Hydropunch™ sampling systems commonly used in site screening programs, the SimulProbe™ obtains the samples simultaneously and at the same depth, enabling direct comparisons of chemical compositions of the different phases of impacted media. In addition, monitoring of vapor purge vacuum provide data that serve as a proxy for in situ pneumatic permeability measurements. These data were used to assist in the design of soil vapor extraction wells "on the fly". The SimulProbe™ Aquifiler™ water Canister allowed for more cost effective profiling groundwater concentrations within an aquifer than would be provided by dedicated discrete sampling systems such the BAT™ or Westbay™ systems. A sensor array installed within the water Aquifiler provided real-time, in situ, measurements of dissolved oxygen, redox, conductivity, pH and temperature. These data when combined with the depth discrete water samples obtained in the Aquifiler™ quickly and effectively identified variations within the aquifer

EMCON used the SimulProbe™ in a rapid site screening investigation of a 13.8-acre RCRA status aerospace facility in Newbury Park, California. Industrial activities from the 1950s through the 1980s caused various hazardous substances to impact subsurface soil, bedrock, and groundwater. Chemical impacts included chlorinated solvents, heavy metals, cyanide, hydrocarbons, and polychlorinated biphenyls. A variety of assessments were conducted, each one identifying new areas of impact. Interim actions, implemented in phases, included removals, physical containment, vapor extraction, and groundwater pumping and treatment. The purpose of the RCRA facility investigation (RFI) was to complete assessment activities and prepare the site for comprehensive remediation in anticipation of redevelopment. The soil and vadose zone RFI consisted of drilling and sampling 86 hollow-stem-auger borings. The 913 feet of boring included 813 feet of predetermined sampling and 100 feet of drilling added to test the vertical and lateral extent of impacts encountered during scheduled sampling. Approximately 315 soil samples and 125 soil vapor samples were field screened and selected samples, analyzed at a fixed laboratory.

RATIONALE OF NEWBURY PARK INVESTIGATION

As described in the *RFI Soil and Vadose Zone Workplan* (EMCON, December 1994), the Newbury Park investigation rapidly screened the site for the lateral and vertical extent of soil and vadose zone impacts. Furthermore, a grid-based investigation supplemented a variety of previous authoritative investigations. One of its objectives was to provide sufficient data to enable selection of a remedy or remedies for the site soil and vadose zone. Consistent with the workplan, the RFI sampling program was based on a grid to provide a high sampling density across the site, since the sampling data were intended for use in the support risk-based remediation and closure of the surface soils for potential residential redevelopment. Samples were field screened to quickly and cost-effectively provide sufficient analytical data to eliminate unimpacted areas from remedial activities. The use of field screening allowed laboratory confirmation analyses to focus on impacted areas.

This grid-based sampling approach was designed to be consistent with the methodology used in evaluating potential residential exposure units (Hadley and Sedman, 1990). This methodology requires a sampling density sufficient to evaluate whether any hot spots might exist. If hot spots remained undetected and unremediated, in a residential backyard, they could result in exposure of residents using the yard for gardening and recreation. Based on a real estate farm report obtained for the Newbury Park area, the average backyard size is 6,000 square feet, or approximately 75

feet by 75 feet. To test numerous hypothetical backyards, a 75-foot-square grid was superimposed onto the site. Borings were situated at the corners and center of each grid, providing a maximum distance of approximately 54 feet between discrete samples, which made detection of any hot spot larger than 50 feet across likely. In addition, supplementary authoritative and semi-random sampling was conducted in various locations.

RATIONALE OF THE SHAFTER RI/FS SUPPLEMENTAL INVESTIGATION

Eleven borings were completed to evaluate the vertical and lateral extent of vadose zone impacts that prior conventional investigations of this former fertilizer and pesticide formulation facility had left undefined. A variety of chlorinated and brominated fumigant compounds, metals, chlorinated insecticides, pesticides and herbicides are present in the site soils. Since volatile constituents were present in concentrations exceeding USEPA Region 9 soil preliminary remediation goals, a remedy for the site would logically include soil vapor extraction. In addition, vapor extraction wells were installed in five borings drilled in the vicinity of VOC hot spots. Also, since the site had not been evaluated with a soil vapor survey, the California EPA, Department of Toxic Substances Control requested that one be conducted. By using the SimulProbe™ sampling system the soil vapor survey was conducted simultaneously with the supplementary soil boring activities, eliminating the need for an additional investigation. On-site mobile labs were used for VOC soil gas and soil matrix analyses, enabling real-time verification of the limits of impact. By integrating the collection of pneumatic permeability data while collecting the soil vapor and soil samples, the design of the vapor extraction wells was conducted "on the fly". These wells will be used in the conduct a soil vapor extraction pilot study.

SOIL AND SOIL VAPOR SAMPLING

The soil boring program included collecting soil and soil vapor samples for chemical analysis. Vapor samples were collected at selected intervals to assess the impact of volatile organic compounds.

At intervals selected for soil vapor sampling, a SimulProbe™ collected soil and soil vapor samples from the same soil horizon. The split-spoon sampler was used at intervals where soil vapor samples were not required. The use of direct push was not appropriate for the two sites because of the presence of dense granular soils and bedrock at the Newbury Park site.

SIMULPROBE™ SAMPLING EQUIPMENT AND SAMPLE ACQUISITION

SimulProbe™ Maxi-Probe equipment was used at selected intervals to collect soil and soil vapor samples from the same soil horizon. The SimulProbe™ Maxi-Probe is a 1.5-foot-long, 2.5-inch-inside-diameter, split-tube, stainless steel drive sampler. The sampler contains three thin-walled stainless steel liners for soil collection, and with a gas transfer interface and Teflon® or polyethylene tubing for soil vapor collection.

For soil vapor sampling, tubing long enough to reach the ground surface from the bottom of the boring is connected to the top of the SimulProbe™ Maxi-Probe. The SimulProbe™ was attached to the downhole wireline by an AW adapter and tubing. The assembly was lowered through the hollow stem of the augers to the bottom of the boring. (Note: in areas where a wireline hollow-stem auger drill rig is not necessary, direct push sample rods and the SimulProbe™ Mini-Probe may be used.) The sampler was driven into the undisturbed soil 1.5 feet ahead of the lead flight auger using a 140-pound hammer dropped 30 inches, as detailed in ASTM D1586. The number of blows required to advance the sampler each 6-inch interval was recorded on a boring log. After the sampler was driven into the soil, it was withdrawn approximately 2 to 3 inches to retract the the sampler from the drive shoe and expose the screen. The soil vapor samples enter through the screen, pass upward through the sampler, and to the surface where each sample is collected. At

the surface, the upper end of the tubing is attached to a vacuum pump equipped with a flow meter and vacuum gauge. After the vacuum is applied, the flow rate is adjusted to approximately 1 cubic foot per minute. The vacuum varied between sample intervals because of soil permeability variations, with higher vacuums noted in tight soils.

To verify that the vacuum line was adequately purged and that representative soil vapors were present before soil vapor collection, a photoionization detector (PID) monitored the exhaust for organic vapors. Once the VOC concentrations in the exhaust stabilized, a soil vapor sample was collected. Required purge times generally ranged from approximately 2 to 4 minutes, depending on the depth of the sample, and the pumping rate. For each soil vapor sample collected, field personnel recorded the date, time, flow rate, vacuum applied, purge time, and maximum PID reading of the exhaust vapor.

Each soil vapor sample was collected in two 10-milliliter syringes. The needle of each syringe was inserted into the vacuum line or an inline Teflon septa, and a soil vapor sample was extracted. After the syringes were filled, the needles were removed from the tubing and the syringes were immediately delivered to an on-site soil gas laboratory for analysis. After the soil vapor was sampled, the SimulProbe™ was removed from the boring and the soil samples were retrieved.

FIELD SCREENING ANALYSES

Field screening included visual, x-ray fluorescence, Hach colorimetric, immunoassay, pH, head space, and soil vapor methods at the Newbury Park site and soil vapor and soil matrix VOCs at the Shafter site. Field screening data were reported daily in electronic format to facilitate decision-making. The use of field screening lowered the Newbury Park projects laboratory analytical costs by about two-thirds.

FAST IN SITU TESTING

FIST, independently conceived of by the author in 1994, uses an enhanced SimulProbe™, sampling system equipped with in line sensors installed with the purge system. The sensors provide real time digital data concerning changes selected media properties. When used in conjunction with the RSS program, the apparatus enabled rapid, single pass subsurface investigation, field screening and the determination of pneumatic permeability. Upon completion of the screening, the boreholes can be used for the installation of monitoring and vapor extraction wells. Since media properties and chemical concentrations are determined in advance, well placement can be optimized with a high level of certainty, providing better data quality and savings of monitoring and remediation costs.

Early in the SimulProbe™ soil and soil vapor sampling program, the flow rate and vacuum data appeared to correlate well with soil type and permeability. A purge data acquisition system was designed and constructed by Dr. Richard Layton of SimulProbe™ Technologies Inc. Purge vacuum data was acquired using a conventional Hermit and pressure transducer system for in situ characterization of soil permeability. In addition to qualitative comparisons of data, quantitative evaluations of the data, similar to slug tests, can be conducted using the transient data. Conducting laboratory air permeability tests, in conjunction with the SimulProbe™ survey, is another procedure that can be used to better quantify the SimulProbe™ data. To accomplish this, Ken Kriley of Vector Soil Testing Laboratories, set up a modified ASTM 4625 Air Permeability test for selected site samples. All tests were conducted under confining pressures similar to the depth where the samples were obtained. Five of the six samples showed a good visual correlation between field data and the lab testing results, suggesting that the procedure is useful for providing quantitative in situ permeability data. These data were used to assist in "on the fly" design of a vapor extraction well system.

SIMULPROBE™ AQUIFILER WATER CANISTER SYSTEM

The Aquifiler water canister can be used, with or without the SimulProbe™ soil sampler. It obtains discrete, pressurized water samples, to minimize the potential for the loss of volatiles from out-gassing during retrieval. To obtain discrete, pressurized water samples, the canister is assembled and pressurized with nitrogen gas. The sampler is lowered to or driven to the depth where the sample is to be obtained. The gas is slowly bled off to the surface, and water enters the canister through a one-way reed valve system. This approach provides a water sample without purging. If conventional purging is required, conventional pumps can be used in tandem with the water canister. In general, once the nitrogen gas bleed off is completed, the water sample is ready for retrieval. The bleed line is repressurized with nitrogen gas, and the sampler is raised to the surface. Once at the surface, pressure is bled off, and a tube is inserted into the bottom reed valve to enable decanting of the water samples to the appropriate sample containers, consistent with standard sampling protocols. The cylinders which constitute the canister can be assembled in increments of 2 liters. Four liter duplex water canister assemblies were used in our Aquifiler sampling.

In the stand alone mode, SimulProbe™ Technologies reports that water samples have been collected at depths of up to 650 feet below grade. EMCON has used the SimulProbe™ Aquifiler water canister, to cost effectively profile groundwater concentrations, and to obtain combined soil and groundwater samples within an aquifer to a depth of 100 feet. To enhance the Aquifiler process, a sensor array was installed within the water Canister to provide real-time, in situ, measurements of dissolved oxygen, redox, conductivity, pH and temperature. These data when combined with the depth discrete water samples obtained in the Aquifiler quickly and effectively identified variations within the aquifer. These data were used to assist in the design of a proprietary, in situ remediation system.

CONCLUSIONS

Through use of a methodology that incorporated the SimulProbe™ multimedia sampler and site screening analysis, reduce the cost and the time to complete site characterization and remediation system design. The availability of real time data allowed the investigation to focus on delineating the impacts identified and obtaining daily regulatory agreement on sampling decisions, limiting the likelihood that iterative, follow-up investigations would be required. The availability of real-time, in situ permeability data from FIST was used to optimally position nested vapor extraction wells. In addition the water Canister provided in situ water samples and aquifer parameters for design of an in situ groundwater treatment system. As a result the SimulProbe™ rapid site screening testing program saved both time and money compared to both conventional and less efficient unconventional methods. The SimulProbe™ is clearly a robust integrated sampling system that provides a better alternative to less optimal sampling technologies.

LETTERS OF RECOMMENDATION



INTERA Inc. • 1650 University Blvd., NE • Suite 300 • Albuquerque, NM 87102, USA • Telephone: 505-246-1600 • Facsimile: 505-246-2600

Mr. Noah R. Heller
SimulProbe Technologies, Inc.
150 Shoreline Hwy., Bldg. E
Mill Valley, CA 94941

Subject: Letter of Recommendation for SimulProbe

Dear Noah,

This is a letter of recommendation based on our most recent experience with the SimulProbe. From September 1996 through January 1997, the MiniSimulProbe was used to simultaneously collect soil and soil gas samples to vertically profile the extent of TCE contamination at the Chemical Waste Landfill site at Sandia National Labs in Albuquerque NM. The simultaneous soil and soil gas samples were collected from 20 feet to approximately 500 feet below ground surface; using an air rotary casing hammer (ARCH) drill rig with a hollow bit. Therefore, the tool could be tripped through the drill bit without having to remove the ARCH drill stem pipe.

Since the MiniSimulProbe was operational with a down hole wire line hammer, significant time and cost savings were achieved in deployment, sampling, and retrieval of the system; compared to the use of a conventional rod based system. Typically, the average sample collection time with the MiniSimulProbe to depths of 500 feet BGS was from 30 to 45 minutes. With a rod based system the time per sampling event would have ranged from 45 minutes to 2 to 3 hours.

The MiniSimulProbe provided crucial data that assisted in determining the placement of the well screen intervals for the shallow SVE wells. The use of the SPLAT drive cone and the MiniSimulProbe extension rod, permitted penetration into the air dilution ring at the bottom of the bore hole before soil and soil gas sampling commenced; thereby avoiding the sampling of the most volatilized or air stripped sediment at the bottom of the bore hole. The MiniSimulProbe could typically be penetrated 3 to 4 feet beyond the drill bit to depths of 300 feet BGS, and from 1 to 3 feet from 300 to 500 feet BGS.

There were two primary problems with operation of the MiniSimulProbe tool at the Sandia site. The first problem was in driving the tool to sufficient penetration below 300 feet BGS due to the very indurated nature of the sediments at these depths; to the point of even drill bit refusal. In the hardest sediments, the MiniSimulProbe would bounce up and down at the bottom at the boring in a futile penetration attempt with a 300 lb. wire line hammer. As a result the SPLAT would some times prerelease, the core recovery would

California • Colorado • Nevada • New Mexico • North Carolina • South Carolina • Texas • Virginia
Canada • England • France • Sweden • Switzerland

be 50% or less, and the penetration into the formation would be 1 foot or less. However, the amount of pounding that the MiniSimulProbe endured in the very hard sediments is a testament to the tools strength and durability. The second problem was related to entanglement or twisting of the Teflon line below 200 feet BGS. The Teflon line was the soil gas pathway between the top of the SimulProbe and the soil gas pump at the surface. However this problem may have been avoided with noncoiling wire line cable. Relative to the cost of the project, the few problems that we had with deployment of the tool paled in comparison to the cost savings and value added accuracy that the MiniSimulProbe provided. Additionally, I would like to thank SimulProbe Technologies, Inc. for the outstanding service they provided during the course of the project and being there for us every step of the way. I would recommend this tool for use on other projects and to others who are interested in cost savings and dramatically improved sampling science.

Best Regards,



Lee Brouillard
Field Operations Manager/Hydrogeologist



EMCON

3300 N. San Fernando Boulevard • Burbank, California 91504 • (818) 841-1160 • Fax (818) 846-9280

January 21, 1997
Project Admin

Mr. Noah R. Heller R.G.
President, SimulProbe Technologies, Inc.
150 Shoreline Highway, Bldg. E (2nd Floor)
Mill Valley, CA 94941

Re: Letter of Recommendation for SimulProbe Sampling System

Dear Mr. Heller:

The purpose of this letter is to provide a recommendation for the sampling system. We used the SimulProbe to simultaneously obtain soil gas and soil matrix samples in a recently completed RCRA Facility Investigation (RFI) conducted in southern California and it greatly expedited the completion of the project. Two years ago when we were negotiating with regulatory agencies on the RFI scope of work we didn't have an alternative to separate soil gas and soil matrix sampling surveys. From prior characterization at the site, we knew that groundwater impacted with parts per million levels of chlorinated volatile organic compounds (CVOCs) occur at depths of 25 to 35 feet below the ground surface. The CVOCs volatilize upwards into the vadose zone from the water table and we anticipated having to follow-up hundreds of soil gas survey "hits" with hundreds of soil matrix samples in a follow-up soil sampling program. The process would have taken months of negotiations to agree on the scope of work and to complete the sampling.

However, between the draft work plan written in December 1994 and the most recent update issued in August 1996, the SimulProbe was introduced. We quickly realized the potential benefit of this sampling tool and incorporated it as a strategic element of our sampling strategy. During the RFI an 87 boring hollow-stem auger drilling program was completed in 8 days EMCON which simultaneously obtained over 120 soil gas samples which were analyzed in a mobile soil gas laboratory. Fifty fixed laboratory confirmatory analyses soil matrix samples were selected on the basis of the soil vapor results. Since the analysis of the SimulProbe soil matrix samples did not confirm the high concentrations of the soil gas samples, we were able to demonstrate to the agency that the soil gas concentrations did not constitute new vadose zone sources requiring additional investigation. The savings to the client are conservatively estimated at \$50,000.

We were also impressed with the durability of the MaxiSimulProbe sampler. Soils at the site are underlain by weathered volcanic bedrock which can be penetrated with difficulty



Mr.Noah R. Heller R.G.
January 21, 1997
Page 2

Project Admin

using drive samplers. The SimulProbe was advanced into the weathered bedrock to obtain vadose zone vapor samples and sustained up to 100 blow counts for a six inch drive in the process.

Finally, we would like to thank the SimulProbe staff, including Mr. Dana Corson for the long hours of quality service expended in support of the sampling program. The conduct of the program was expedited by the full service support provided.

In conclusion I would like to encourage others the environmental industry to use this exciting new sampling tool and experience the benefits it can provide for themselves. Should you have questions about our experience using SimulProbe, please do not hesitate to call.

Sincerely,

EMCON

A handwritten signature in cursive script, reading "Donald L. Marcus".

Donald L. Marcus CEG
Technology Manager

February 6, 1997

Noah Heller
SimulProbe Technologies, Inc.
150 Shoreline Highway, Building E, 2nd Floor
Mill Valley, California 94941

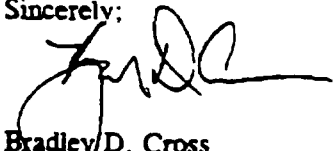
Dear Mr. Heller:

I am preparing this letter to serve as a letter of recommendation to other potential users of the SimulProbe sampling equipment. Over the last six months, Levine-Fricke-Recon (LFR) has used both the Maxi-SimulProbe and Mini-SimulProbe at a Federal Superfund site in Arizona. At that site, the SimulProbe provided a method of collecting depth-specific soil and groundwater samples up to 700 feet below the surface within a highly interbedded alluvial aquifer. By using the SimulProbe along with onsite laboratory equipment, we were able to characterize the vertical extent of volatile organic compounds in soil and groundwater at each drilling location, as the drilling progressed. This allowed us to effectively select screen intervals for groundwater monitoring and extraction wells, and minimize the potential for cross-contamination due to improperly screened wells. It also allowed us to develop an effective monitor well network with a minimum number of wells (over a third less wells than initially proposed), saving our clients a lot of money.

Analytical testing of water samples collected using the SimulProbe correlate very well with monitoring well data, lending confidence to the procedure. Unlike some other in-situ sampling devices, the SimulProbe water collection chamber can be opened and re sealed in place from the surface so that down-hole cross contamination is not a concern. The SimulProbe also proved to be very durable and fairly easy to use. SimulProbe staff were on hand to provide training and assistance when needed, and our field staff were generally up to speed on assembly, sampling and decontamination procedures within the first day of use. Decontamination between sampling intervals was relatively easy and facilitated by disposable, pre-packaged assembly parts that would otherwise be cumbersome to decontaminate with each use. Down time for sampling was minimal with a typical sampling event using a wireline and downhole hammer generally taking between twenty and forty minutes.

The SimulProbe proved to be an extremely valuable tool and we intend to continue using the SimulProbe on our project in Arizona and at other sites as well. I would highly recommend the SimulProbe as an effective, accurate, and cost saving subsurface sampling technique particularly for characterization of soil and water quality within highly interbedded or heterogeneous materials.

Sincerely;



Bradley D. Cross
Senior Associate Hydrogeologist

March 21, 1996

LF 1583.95-09

Mr. Noah R. Heller
SimulProbe Technologies, Inc.
150 Shoreline Highway Bldg. E (2nd Floor)
Mill Valley, California 94941

Subject: Letter of Recommendation for SimulProbe

Dear Noah:

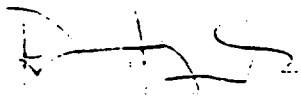
As discussed earlier, this is a letter of recommendation based on our recent experience with the SimulProbe. Prior to setting an extraction well, we used the SimulProbe to collect discrete soil and groundwater samples from both aquifer and aquitard soils affected with volatile organic compounds (VOCs). We were successful in delineating the vertical extent of VOCs in soil and groundwater, with the final samples being collected at 330 feet below ground surface.

Our success with the SimulProbe sampler was due to two key aspects. First, the SimulProbe performed as promised, and quite frankly, beyond our expectations given the conditions encountered at the site. For soil, the SimulProbe performed as well, if not better, than a standard split-spoon sampler. For groundwater, there may be no other sampling technique available that could have given us the same high degree of confidence that our sampling was depth-specific and representative of true aquifer conditions. Collecting soil and groundwater samples simultaneously was a bonus for the project and our client.

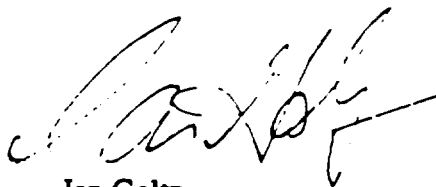
Second, the technical support provided by SimulProbe Technologies, Inc., was excellent, and it guaranteed the success of the well installation program. Thanks again for your efforts both in and out of the field.

We look forward to using the SimulProbe again.

Sincerely,



Dina Kourda
Staff Hydrogeologist



Ian Goltz
Senior Hydrogeologist

December 12, 1996

Ms. Emily Roth
U.S. Environmental Protection Agency
Mail Code H-7-2
75 Hawthorne Street
San Francisco, California 94105

Subject: Lower MAU Investigation Results
North Indian Bend Wash (NIBW)
Scottsdale, Arizona



Dear Ms. Roth:

At this time, a majority of the field work associated with the NIBW lower-MAU investigation is complete. The Participating Companies are submitting the following information for your use:

- preliminary cross-section showing lower-MAU wells;
- summary table of Simulprobe water sample analytical results;
- summary table of Simulprobe soil sample analytical results; and
- summary table of well development water and pumping test water analytical results.

Additional analytical results and supporting documents will be provided at a later date.

Sincerely,

Katherine S. Roxlo
Senior Geologist

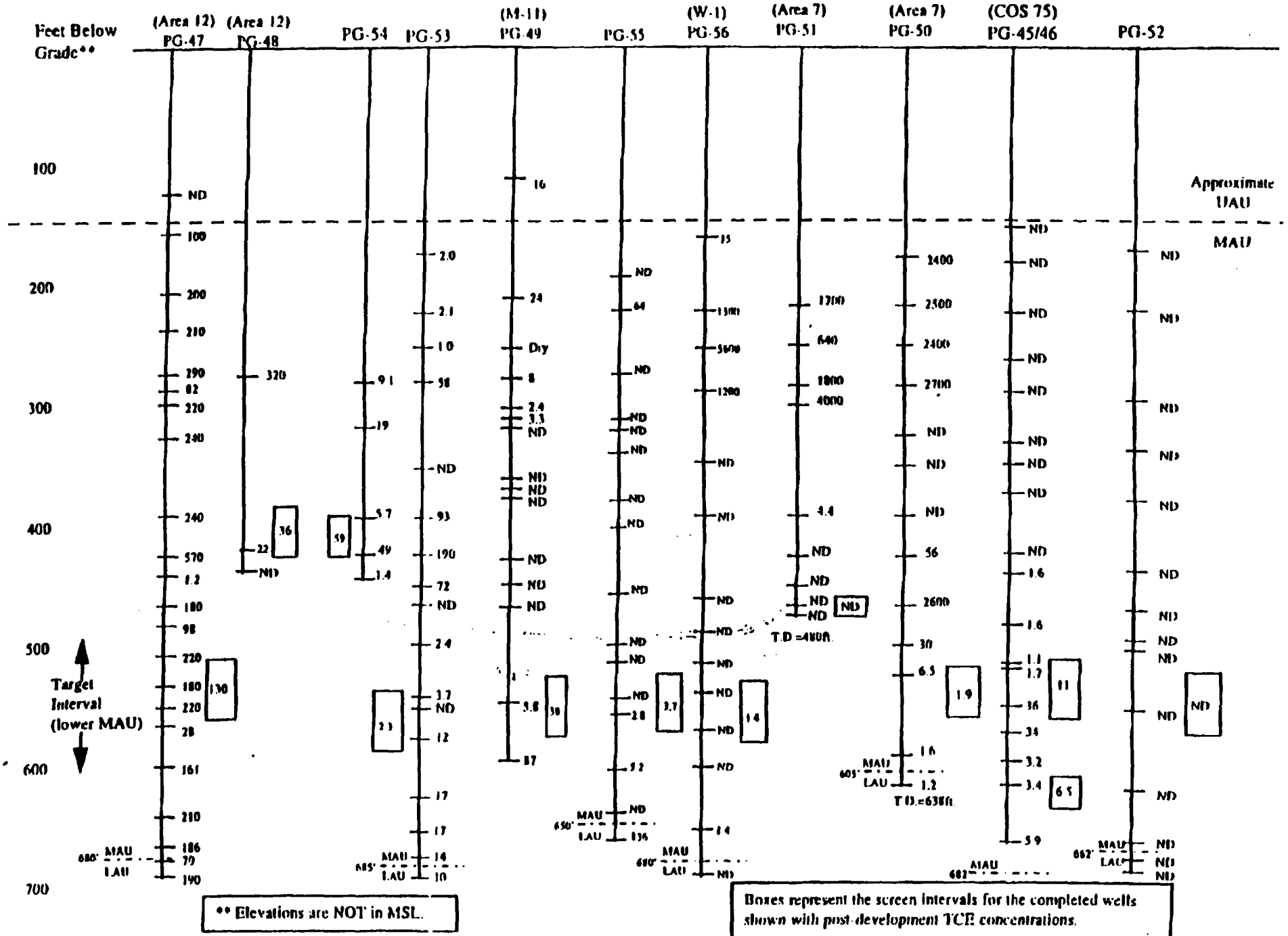
Attachment

cc: Dennis Shirley, Motorola, Inc.
Tom Beggs, SmithKline-Beecham
John Wyss, Siemens Components, Inc.
Ron DeWitt, Montgomery & Associates

Tim Graves, CH2M Hill
Nick Hazelwood, NIBW PCs
Phil Whitmore, ADEQ

TCE Concentrations for MAU Drilling Project (as of 12/4/96)

PRELIMINARY DRAFT
FOR DISCUSSION
PURPOSES ONLY



AEI Amador Engineering & Infrastructure, Inc.

July 16, 1997

Mr. Noah Heller
SimulProbe Technologies, Inc.
150 Shoreline Highway, Building E, 2nd Floor
Mill Valley, California 94941

Subject: Maxi-SimulProbe Sampling for Natural Attenuation

Dear Mr. Heller:

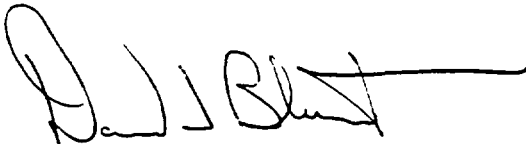
I have prepared this letter to discuss use of the Maxi-SimulProbe sampler for one of our projects in the Central Valley, California. Amador Engineering & Infrastructure, Inc. (AEI) successfully used the Maxi-SimulProbe with the 2-liter water canister for discrete sampling in sands, silts and clayey sands associated with interbedded lacustrine deposits. In addition to soil samples collected, the Maxi-SimulProbe successfully collected soil pore-water samples for TPH-g, BTEX, dissolved oxygen, nitrate, ferrous iron, sulfate and methane with plenty of water retrieved for additional testing of field parameters.

The data was reproducible and correlated between exploratory borings. The Maxi-SimulProbe data allowed precise calculation of the mass of dissolved hydrocarbons. Furthermore, as an example, the vertical distribution of ND samples of dissolved oxygen and nitrate provided definitive evidence of microbiological mediated chemical reactions. Reproducible ND findings confirmed discrete sampling without cross-contamination.

SimulProbe Technologies, Inc. added value to the investigation program by providing technical assistance in the field during our initial startup.

AEI is planning the use of the Maxi-SimulProbe tool on other important sites, and has already been asked to present these kind of information at national conferences. Thank you.

Sincerely,
AMADOR ENGINEERING & INFRASTRUCTURE, INC.



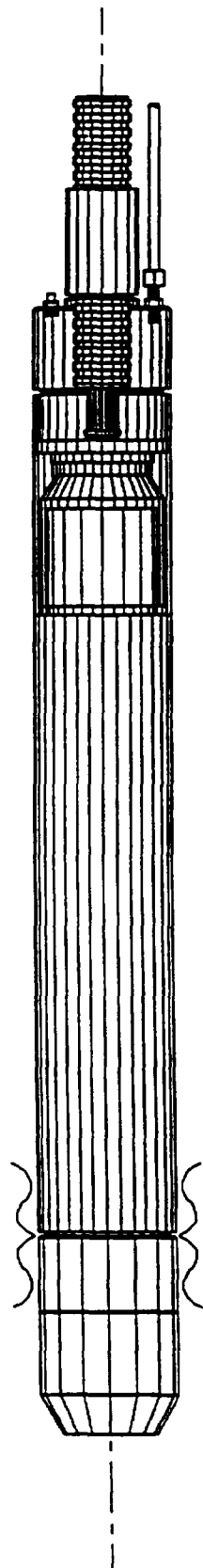
David J. Blunt RG
Principal Environmental Geologist

SCHEMATICS

MAXI-SIMULPROBE®

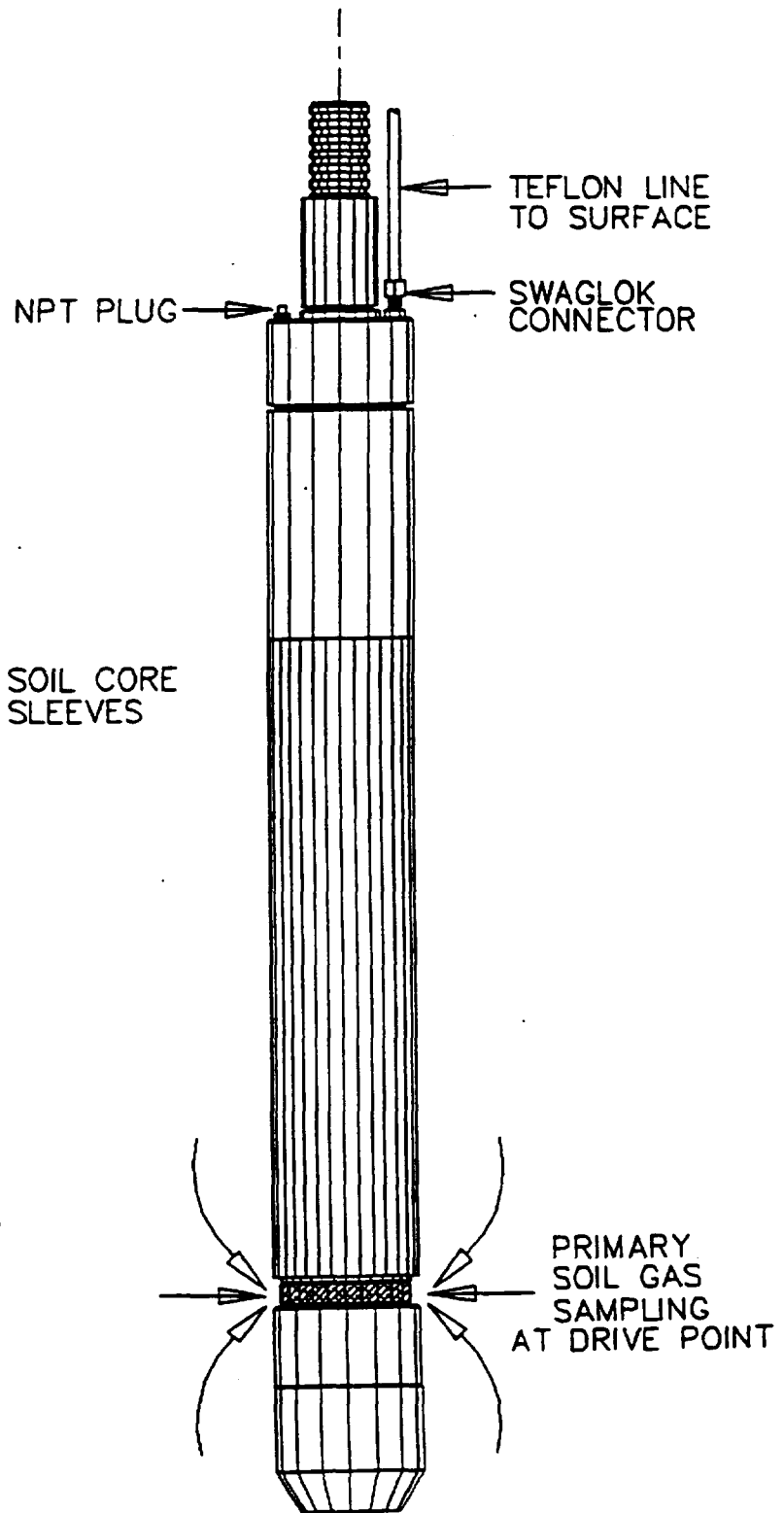
SOIL / SOIL GAS MODE

TO RIG



CLOSED

TO RIG



OPEN

MAXI-SIMULPROBE[®]

SOIL / GROUNDWATER

TO RIG

TO RIG

CONDOM

TEFLON LINE
TO SURFACE

NPT PLUG

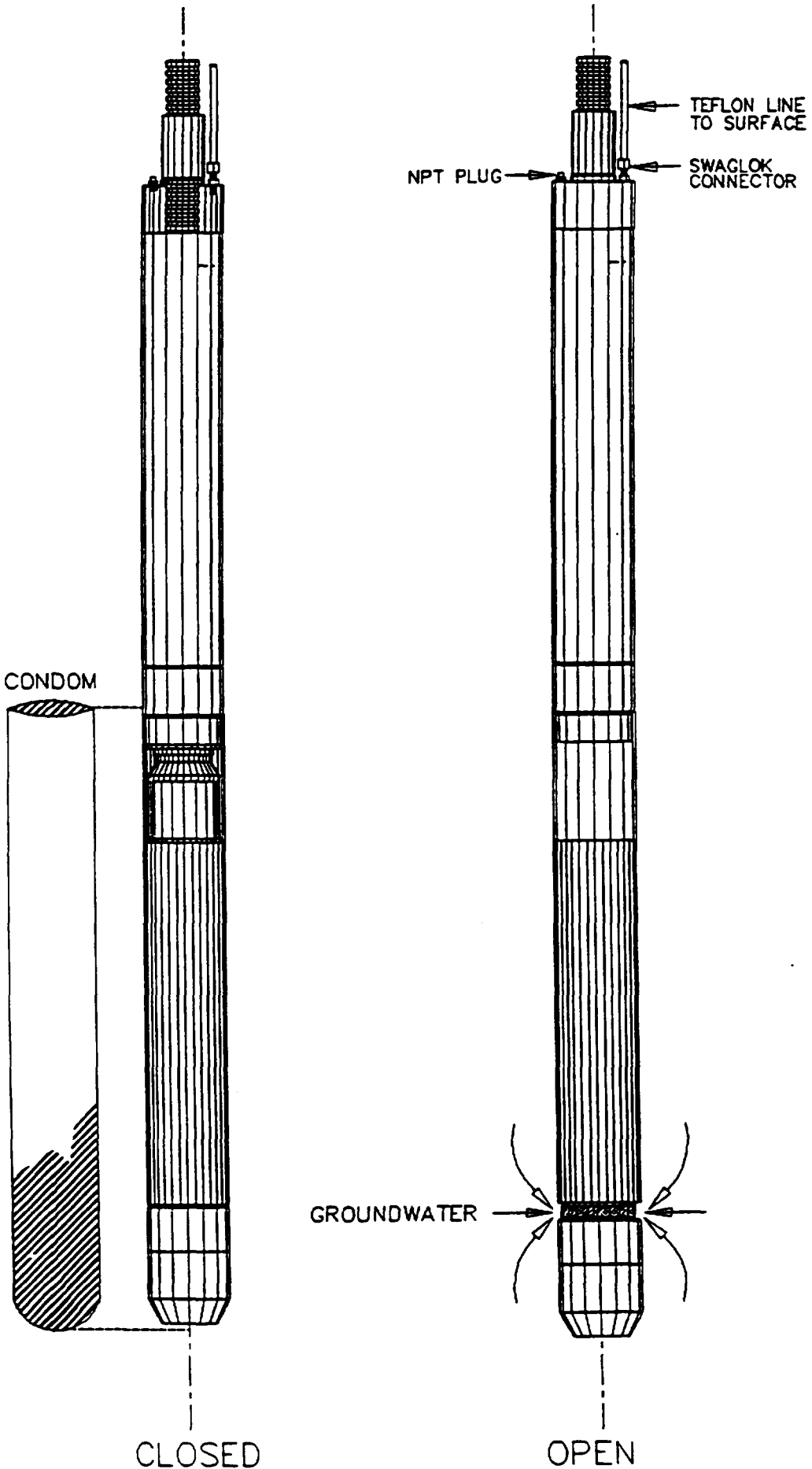
SWAGLOK
CONNECTOR

GROUNDWATER

CLOSED

OPEN

CAD FILE: GWMAXI-C2.DWG



MINI-SIMULPROBE®

SOIL/ SOIL-GAS MODE

SOIL GAS
TO SURFACE
THRU SLOTTED AW PIN
OR HOLLOW DRIVE RODS
(TYP.)

"DRIVE & SNIFF"
RECONNAISSANCE
SAMPLING

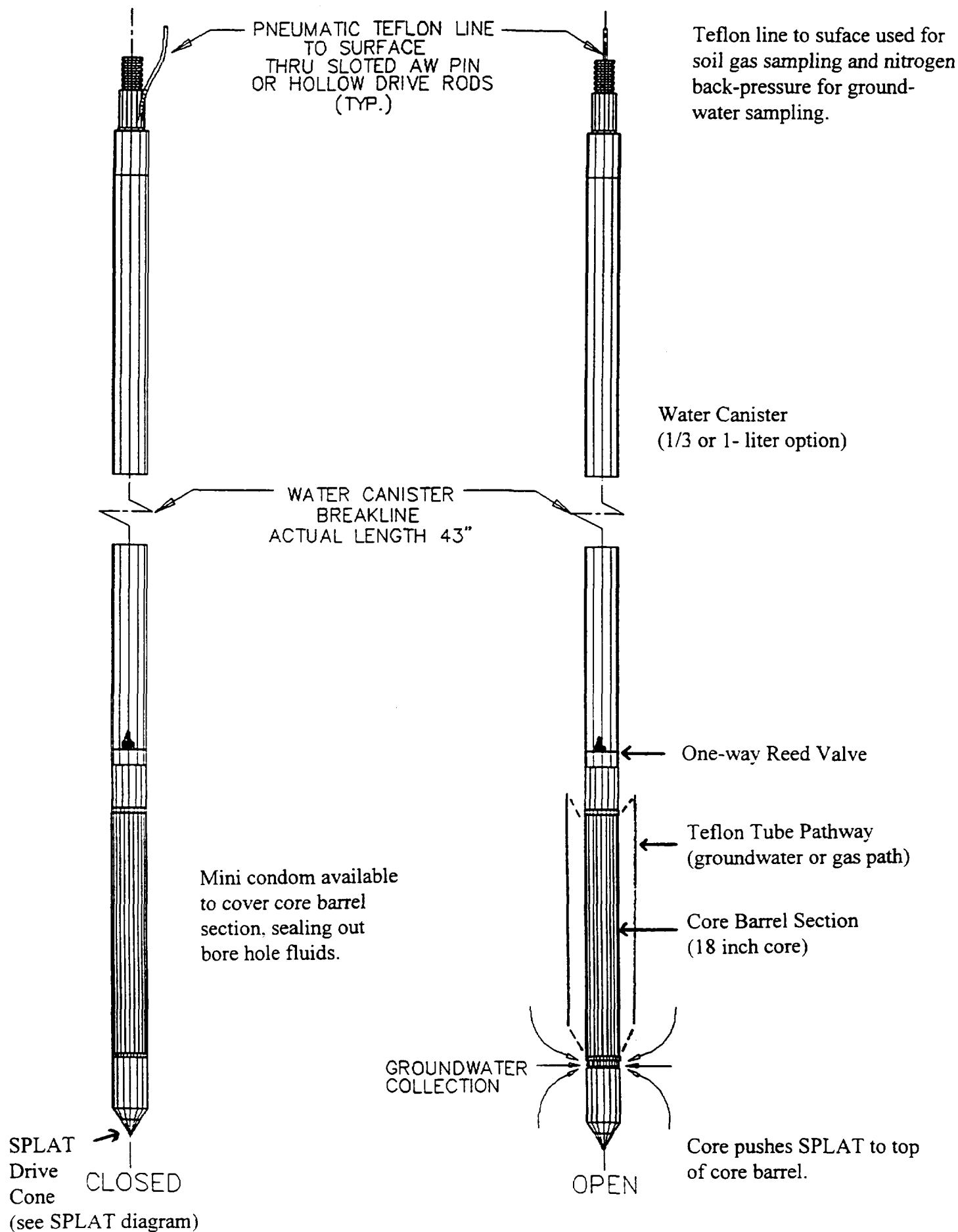
SOIL GAS
COLLECTION

CLOSED POSITION

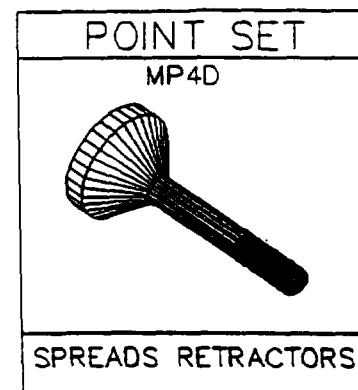
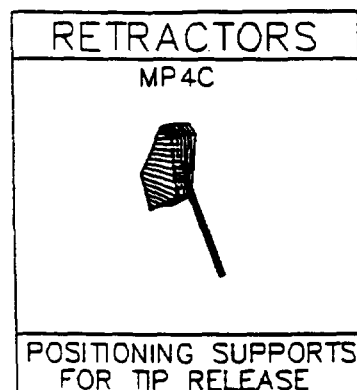
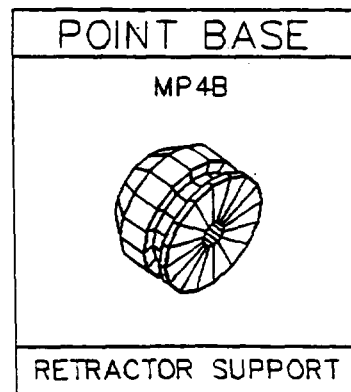
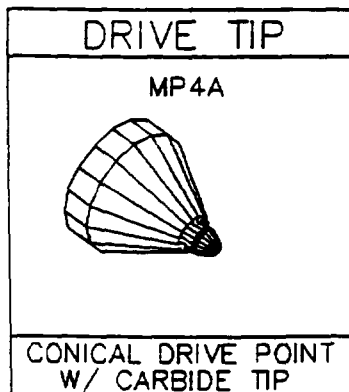
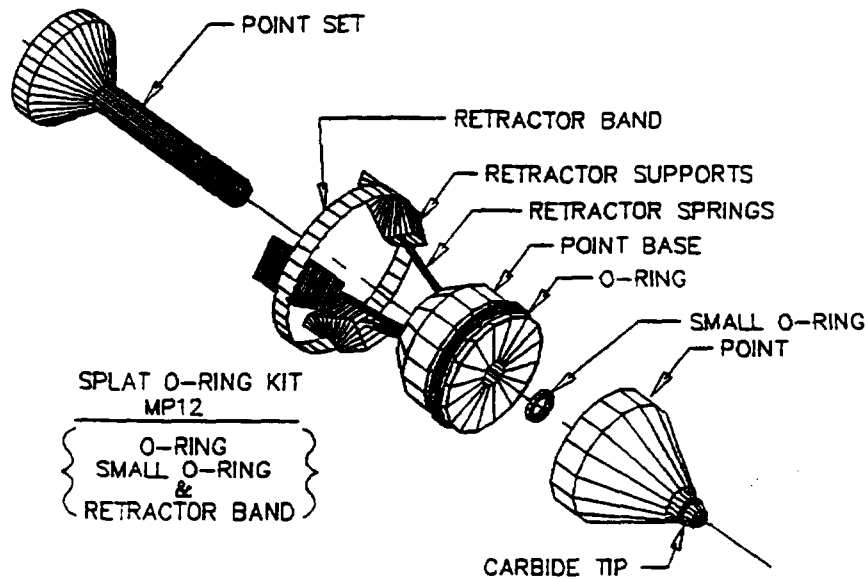
OPEN POSITION

MINI-SIMULPROBE[®]

GROUNDWATER MODE



SIMULPROBE SPLAT™ ASSEMBLY



SimulProbe Technologies Inc. has developed and patented a discreet sampling system called SPLAT (SimulProbe Latch Activated Tip), that is 100 % contained in the drive shoe. The SPLAT allows the operator to take samples at depth without the use of time consuming control rods, AW rods, threaded stop pins, or drop weights.

The SPLAT drive cone allows the operator to take a discreet sample at targeted depth without the aid of inner rods and stop pin. After reaching your desired depth, the operator simply pulls back on the wire line or drive rods to release the SPLAT drive cone and then continue driving another 18 inches to fill the split tube. The SPLAT can be run with or without sample liners.

PRICE LIST

RENTAL PRICE SHEET

RENTAL PROGRAM	DAILY RATE	WEEKLY RATE
MAXI SIMULPROBE	\$150	\$650
W/O WATER CANISTER	\$125	\$500
MINI SIMULPROBE	\$150	\$650
W/O WATER CANISTER	\$125	\$500
WATER CANISTER	\$50	\$200
VACUUM BOX	\$50	\$150
SOIL GAS VACUUM PUMP	\$50	\$150
(Mounted in tool box carrying case.)		
Includes: Jumper cable for 12-volt battery power supply, control switch, 30-amp fuse, fittings & spare parts.		
SPOOL/TANK/REGULATOR	\$50	\$150
SPOOL	\$10	\$50
REGULATOR	\$20	\$75
TANK	\$10.00	\$50
PERISTALTIC PUMP	\$50	\$150
(With carrying case & jumper cables for 12-volt battery power supply.)		
ALL RENTED EQUIPMENT MUST BE RETURNED FULLY CLEANED AND DECONTAMINATED. ANY UNIT RETURNED WHICH HAS NOT BEEN FULLY CLEANED AND DECONTAMINATED WILL BE SUBJECT TO A \$500.00 CLEANING FEE.		
RENTAL UNITS MAY <u>NOT</u> BE USED FOR SAMPLING OF RADIOACTIVE SUBSTANCES.		

SIMULPROBE TECHNOLOGIES, INC.**CONSUMABLES PRICE LIST****PRICE (IN QTY 10 OR >)****(IN QTY 11 OR <)****MINI GROUND WATER KIT****\$42.50****\$40.00****MINI SOIL GAS KIT****\$17.50****\$14.50****MINI CORE SLEEVES 3"****\$2.75****MINI CORE SLEEVES "6****\$3.00****MINI END CAPS****\$0.20****MAXI GROUND WATER KIT****\$45.00****\$40.00****MAXI SOIL GAS KIT****\$20.00****\$17.50****MAXI CORE SLEEVES****\$4.00****MAXI END CAPS****\$0.30**

Prices as of June 1997

SIMULPROBE® TECHNOLOGIES, INC.		
SAMPLING TOOLS PRICE LIST		
ITEM & PART NO.		PRICE
THE MINI SIMULPROBE®		
MP-1	Fully assembly with 1-liter stainless steel water canister and SPLAT™ tip for direct push. 2" outer diameter split spoon. Collects 1.25" diameter x 21" core.	\$4,250
MP-1A	Without water canister assembly.	\$3,250
THE MAXI SIMULPROBE®		
MX-1	Fully assembly with 2-liter stainless steel water canister. 3.38" outer diameter split spoon. Collects 2.5" diameter x 21" core.	\$4,500
MX-1A	Without water canister assembly.	\$3,500
THE SIMULPROBE® CORE BARREL		
MCB-1	Full assembly with SPLAT™ tip for direct push. 2" outer diameter split spoon collects 1.25" x 2.5" core.	\$595
Prices as of June 1997		